DOCUMENT RESUME

ED 260 950 SO 016 220

AUTHOR Anderson, Sara F.
TITLE Wielding the Double-Edged Sword: Techniques for Teaching about Technology-Related Social Issues.
PUB DATE Nov 84
NOTE 27p.; Paper presented at the Annual Meeting of the National Council for the Social Studies (64th, Washington, DC November 15-19, 1984).
AVAILABLE FROM Sara F. Anderson, 2815 Key Boulevard, Arlington, VA (703 525-2139).
PUB TYPE Viewpoints (120) -- Speeches/Conference Papers (150)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Cultural Awareness; Higher Education; Instructional Materials; Learning Activities; *Science Education; Secondary Education; *Social Problems; *Social Studies; Teaching Methods; *Technological Advancement; Technological Literacy; Technology
IDENTIFIERS *Science and Society

ABSTRACT

This document on technology-related social issues has two parts. The first part is an essay which defines technological literacy and considers the relationship between society, culture, and technological innovations. In this essay the impact of technological innovation on nine strands in the socio-cultural system is examined. These strands are: science, engineering, technology, societal goals and values, the economic system, the political system, the societal/family system, the educational system, and the religious system. From the perspective of this systems analysis, goals and objectives for developing technological literacy in students are outlined, including: developing a holistic view of society and culture, developing an understanding of conflict as part of the necessary tension within a cultural system, establishing competence in understanding technological change, and developing respect for the natural world. Following the essay is a paper describing classroom activities designed to introduce students to historical and current technological innovations and their impact on society. In several class periods, students pick a single historical or contemporary innovation, list the effects of this innovation on our culture, categorize those events as planned or unforeseen, indicate whether the effects were local, regional, national, or global, and divide the effects into positive and negative. A chart is provided to help students analyze these changes and their impact. (LP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED260950

Sara F. Anderson
2815 Key Boulevard
Arlington, VA. 22201
(703) 525-2139

Paper presented
at 64th Annual Meeting
of the National Council
for the Social Studies,
Washington, D.C. Nov., 1984

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☒ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sara F. Anderson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Wielding the Double-edged Sword:
Techniques for teaching about Technology-related Social Issues.

by
Sara F. Anderson

SO 016 220

It has become almost a truism to say that nearly all the major issues facing our nation today involve science and technology. Additionally, there is enough agreement among educators that such issues need to be studied in high school and college social studies and social science courses, that we can accept these statements as givens for this presentation.

The inter-relations between and among the scientific community, technologists and engineers and the general public, the government and other institutions are multifaceted and complex. If we are to attempt to teach our students about social and political issues which contain a scientific or technical component, we must have some understanding of those inter-relations.

Our goals today are first, to increase our own understanding of some of the ways in which science and technology are changing our society and in which society affects science and technology. Second, to participate in some activities involving technology assessment from the individual's perspective. These activities can be adapted for use in several social studies and social science courses.

In order to clarify our understanding of what the goals of education about technology-related social issues are, let's explore the concept of technological literacy. This term is to be preferred to scientific literacy since, according to Morris Shamos (1983), scientific explanations generally do not accord with everyday experience of our students, and abstractions in science are frequently mathematical statements, which cannot be easily translated into ordinary language. Technology, on the other hand, requires little abstract reasoning and only passing acquaintance with concepts of science. The objective, then, is to make people feel comfortable with the objects they use. To do so they should have enough understanding of how those objects work to have a sense of being in control of these products and to know the capabilities and limitations of the machines they use in their work and leisure. To achieve this objective, the complex of skills and knowledge encompassed in the concept technological literacy can be taught. Among these skills are the following. First, obtaining general knowledge of how various machines work, and of basic scientific concepts such as change, probability and the cellular/atomic nature of matter. Second, students need to be aware that scientific knowledge is tentative, testable, relies heavily on the concept of probability, and is constantly in a state of flux. Yet, at the same time, they need to be aware of the power the knowledge provided by science and technology combined. It is the basis for further

investigations of both scientific phenomena and of technological issues, of problem-solving and innovation in the production and delivery of goods and services. More importantly, both individually and as a society, we rely on knowledge as the basis of our world view--an idea we will explore in more detail later---and finally, the basis of technological innovations and of effective use of the products of technology. (Harrison, 1984)

Technological literacy includes as well some awareness of the nature of the process of cultural change fueled by technological innovation, and of the ways in which cultural goals and values affect the direction and scope of scientific research and technological innovation.

An important aspect of technological literacy, which is frequently over-looked by educators and scientists writing about the topic, is the ability to communicate effectively and to reflect qualitatively as well as quantitatively on information. (Carey, 1983) Students need to be able to see others' viewpoints and to understand their own and other cultures, and to read literature and history with comprehension. Thus, at a time when liberal arts colleges are introducing courses on computers and quantitative reasoning into their curriculum, technical schools are adding courses on using the social sciences and humanities to be more effective engineers, technicians and scientists. (New York Times Spring Survey of Education, April 21, 1983 and Science-Technology and Society courses at Lehigh, Wesleyan and other universities.) The message seems to be that in the future, we will need to be able to walk with one foot in each of the "two cultures" of the humanities and the sciences.

Finally, students will need to be able to continue learning throughout their lives. As the specific facts they learn in school become replaced

and out-dated, they will need skills and processes by which they can learn new information on their own. These skills form the basis of technological literacy for the Twenty-first Century.

Our concern today is with the aspect of technological literacy which involves understanding the relationship between society and culture and technological innovation, and of assessing the likely impact current innovations are having and may have on our society and culture.

Society and Culture Viewed as Systems.

The inter-relations between society and culture on one hand and the technological and scientific advances made within that culture on the other are many and complex. We can aspire only to discuss only a few of the major areas of this interaction.

The framework within which we will view the entire topic is the systems view. In this view, society and culture are to be seen as complex whole entities, composed of complicated parts which interact through complex newtorks of interaction. The whole system is qualitatively different form the simple sum of its parts; studying parts and attempting to just paste them together does not give an accurate view of the whole. Systems exhibit goal-seeking behavior governed by feedback from the environment to the system, the system to the environment, and within and among the components of the system. Systems are determinant, yet changing, so that as time passes, the state of a system is characterized more by its experiences than by its initial state. Each system has an optimum state of tension; too little tension leads to stagnation and too much tension to "stress." The optimal state is one of "dynamic equilibrium." Change is continuous in the system, and results in a new qualitatively different state of equilibrium than the one that preced

the change. Some examples of systems are individual personalities, families, institutions and, as we are using it today, entire socio-cultural complex existing in a given place and time. (Buckley, 1967)

Using the systems view, the first thing which becomes apparent is that society and science plus technology are not separate entities. Rather, science develops and technology is introduced within the context of the culture.

Nine major strands can be identitied in the socio-cultural system. These strands in their various configurations and amounts, form the fabric of the socio-cultural systems. The strands are the following.

1. Science. Science is the process of investigating physical, behavioral and social phenomena. The process includes everything the investigator does from choosing the topic and formulating the questions to the validation of the results. (Harrison, 1984) Thus science is the study of the natural world, of what in fact, exists. Basic science is motivated by the desire to know, apart from any use the knowledge generated may have.

2. Engineering. The process of investigating how to solve problems and again, the process includes everything from the choice of the problem (that is, deciding what situations should be defined as problems) to the validation of the solution. In the past, it has been concerned almost exclusively with physical and chemical phenomena. Now we have developed the capability to apply engineering processes to problems using information from biology as well. (Harrison, 1984)

3. Technology. The process of production and delivery of goods and services. Technological innovation is the process of investigation leading to more effective production and delivery.

The relation among these three strands is synergistic--each drives the others and supports them. What results in an enormously productive system of knowledge generation. (Harrison, 1984)

4. Societal goals and values. Every society has a few major values which influence many of the goals sought by individuals and the society as a unit. One such value in the United States is individual freedom. We will discuss how this value influences the science and technology we support in the next section.

5. Economic system. The system of producing and distributing and delivering the wealth of the society is, as noted above, closely tied to the technology available to and developed by that society at any given point in time. It is influenced in its particulars by the prevailing societal values--or is it the determinant of those values? External forces such as the availability of particular raw materials have an impact on the workings of the economic system.

6. Political system. The political system mediates among the other strands and is the locus of many decisions regarding which societal goals and values will be implemented into policies and actions.

7. Social and family system. This is the structure within which children are socialized and nurtured. The specific structure frequently reflects the economic and political systems, for example, in being either democratic or authoritarian.

8. Education system. This system is designed to further the socialization process and to prepare people to take their place in the culture. In slowly-changing systems, educational tasks are clear. In rapidly-changing systems, there is controversy over whether the education system should

further the existing system or be in the forefront of bringing about change. Neil Postman in Teaching as a Conserving Activity (1979) states that in rapidly changing societies, schools should teach skills and attitudes which conserve the best of the old. For example, he says that currently when children get much of their information from television in fragmented bits, the school should teach the skills of reflection, synthesis, and looking at whole "forests." When society is resisting change, schools should be a force for bringing about chage to enable young people to better cope with the emerging culture. (Postman, 1979)

9. Religious system. The religion of a society explains that which cannot be otherwise explained and provides a source of a world-view and philosophy which mold individuals' ethics and values.

To illustrate the systemic nature of cultures, we will use a relatively simple example which shows how replacing one kind of technoloyical object with another alters the entire system. When Lapps were given snowmobiles it made their previously self-sufficient economy dependent on outside sources of fuel and spare parts. In addition, the snowmobiles frightened the reindeer so that they did not reproduce well. This caused dislocations in the entire culture. (Hannay and McGinn, 1980)

The influence of Society and Culture on Science and TEchnology.

Society and culture affect science and technology by defining through goals and values the nature and type of questions which will be investigated in basic research, the types of technologies which will be developed and the specific ways in which those technologies

will be adopted. For example, our society values independence, individual freedom and the right of people to control many aspects of their lives. Thus we have developed not only birth control methods to allow couples to plan when and how many children to have; but also various methods, such as in vitro fertilization of human ova, which permit couples with some kinds of infertility to have children who are genetically their own. The first of these innovations affected the number of adoptable infants available, either directly or indirectly as part of a complex change in societal attutudes toward giving birth out of wedlock. Freed from the stigma formerly attached to being an unwed mother and spurred by psychological needs, many women now opt to keep their children. This drop in the number of infants available for adoption, coupled with renewed interest in the influence of genetic make-up on abilities and social behavior, contributed to the demand for new methods for treating infertility. An economist would point out that this phenomenon can be seen as an example of how the concept of the marketplace operates to influence the speed, direction and specific nature of technological innovation in a particular culture.

In a democracy, the society speaks through the government as well as through the marketplace. Government influences both basic scientific research and technological tinkering by defining situations seen as problems to be solved through engineering and technology. Government assigns priorities by its funding practices, by specifying conditions to be met in order to receive funding, e.g. protection of human subjects; safety of procedures and products and other such regulations; decisions permitting, denying, limiting or mandating the use of technology(e.g. the

Swine Flu innoculation program in 1975). The judiciary influences science and technology by deciding whether or not to hear cases involving alleged technology-related abuses or illegalities, and the decisions made in such cases. Recently, for example, the American Society for the Prevention of Cruelty to Animals and Jeremy Rifkin's Foundation on Economic Trends filed suit against researchers who planned to insert the gene responsible for human growth hormone into pigs and cattle. (Chronicle of Higher Education, October/0, 1984.)

More direct social control of scientific research occurred in the late 1970's when city councils in Cambridge, Massachusetts, San Deigo California and Princeton, New Jersey drew up ordinances stating the precautions which scientistists doing recombinant DNA research in their communities would have to take. (Grobstein, 1979)

Cultural roles and structures affect the ways in which specific technologies are adapted to meet the needs of the culture. For example, the Japanese have industrialized and adopted many Western technological products and processes, but within the context of their own culture. Thus, the structure and management processes of Japanese industries are unique.

The Impact of Technological Innovation on Culture.

To reverse the coin, technology, once adopted, alters the culture. These alterations can be categorized in several ways. There are planned and unplanned effects, short- and long-term effects, positive and negative ones. The technology assessment acctivity in which we will participate today asks students to categorize the effects of technology they list.

Two hallmarks of cultural change attributable to technological innovations during the past century include the rapidity of change, making the lives of each generation very different from the ones immediately preceding and following it, and complicating the relationships between parents and children; and the widening areas of choice available to humans, making skills in decision-making a necessary part of every person's education.

Another type of change is in human thinking. Technology has become our answer to problems. While many problems, such as the eradication of small pox did lend themselves to a linear type of technological approach, other problems, such as the eradication of cancer do not. The social, cultural, and psychological barriers to solutions are often ignored by those who attempt to develop and introduce technological innovations. Such considerations must be taken into account if technology is to truely enhance human life.

The technological mentality, the search for a technological answer to every problem misleads us. Naisbitt (1983) comments

> In our minds, at least, technology is always on the verge of liberating us from personal discipline and responsibility. Only it never does and never will. (p. 51)

Recently the introduction of the widespread use of computers has influenced our thinking about ourselves and about the concepts of "mind" and "human." Sherry Turkle in The Second Self (1984) describes some of these effects. She notes that children under the age of six or seven are very concerned about whether the computer or the toy such as "Merlin" is "alive," and they discuss to great length whether or not it is alive

and whether it can really "cheat." Elementary school age children are concerned with developing their competency in creating the effects they desire with the computer. They bring their personal style to the computer; some are "hard" in their approach, demanding perfection from their programs and achieving complete control over the machine. Others treat the machine as a person, not expecting it to be perfect, and programming in a more relational style. For many children, the computer is an interactive entity which is more reliable and less scary than humans who are more unpredictable and hard to control. The adolescent uses the computer to work out some aspects of his or her (although this is more true of boys,in general) identity crisis. They speak of themselves in computer metaphors, talking of how they are "wired" or "programmed" and of "debugging" their personalities. These metaphors, Turkle notes, are limited in their accuracy and the actual effectivness which they offer the young people.

Adults approach the computer in one of three ways, in general. There are the "hackers" who disdain those who see the computer as a tool to be used to achieve other ends, and who love the machine for itself. For them the end is the programming itself; the risk-taking as they see how close they can come to making the whole program crash before they rescue it. Those working with artificial intelligence believe that human thought will be replicated by computers, and reduce mind to only electrical impulses.

In short, Turkle concludes that there is no "the effect" of computer use. There are many effects, the specific nature of which are largely determined by the personalities of the humans who use them.

Anderson, p. 12 "Wielding the Double-edged Sword."

One general response to high technology has been the evolution of a highly personal value system to compensate for the impersonality of highly technological systems. John Naisbitt states in Megatrends (1983, p. 37) that

> The gee-whiz futurists are always wrong becuase they believe technological innovation travels in a straight line. It doesn't. It weaves and bobs and lurches and sputters."

Naisbitt goes on to cite examples of high technology spawning what he terms "high-touch" responses. The more we have word processors in offices, the more we write memos by hand. The more technology we have in hospitals, the less we are being born and dying there--birthing cheters and hospices are high-touch responses to the impersonal high-tech world of the modern hospital. Computers are being used to individualize pension plans, time schedules and other aspects of the employer-employee relationship. The electronic cottage will not become widely popular because people want to go out to work, to mingle with others. Toffler (1980) discusses the use of computers to individualize products, to produce small "mouse milk" batches rather than relying on mass production. He also describes the factory of the future as being quieter, less physically and psychologically demanding than in the past. (p. 182)

The trends identified by Naisbitt (1983) provide a framework in which to discuss some aspects of current changes.

1. Industrial society bceoming an information society. This trend has also been identified by Bell (1973) and Toffler (1980). In the future electronic and biotechnological industries will be of more importance

than heavy industries such as steel and machinery production. But, we will also need industries to produce steel, concrete and other heavy products to keep up our homes, roads, bridges and other such.

2. The national economy will become more entwined in a global economy.

3. Centralization is giving way to decentralization. Toffler (1980) notes this same effect. Naisbitt points to the return to regional architechure in response to higher fuel costs; neighborhood planning in cities, and the move from cities to small towns of a substantial portion of the popeulation.

In The Third Wave (1980), Toffler states that in the future we will be required to expand the Bill of Rights to take into account threats to our freedom unimaginable in 1789. As the government can mobilize more and better means of control, through electronic means, psychoactive drugs, behavior modificatinn and so forth, we need new government structures capable of making intelligent, democratic decisions rapidly.

Toffler notes several key principles in "third Wave" democracy. These include (i) minority power--allowing for diversity among people; just as we will have diversity in products. Majority rule in the Industrial age (Toffler's "Second Wave") was humanizing and liberating. However, in the "Third Wave" world, majority rule will be seen as dehumanizing and as limiting the freedom of minorities. The rising of minority activism is not the result of a sudden rush of selfishness, but a reflection of the needs of anew system of production which requires for its existence a far more varied, colorful, open and diverse society. (p. 421) In order to get rid of our fear of conflict and to develop new

and creative ways to accomodate conflict within the system. In addition, it appears to this author, that we need to free ourselves from the "zero-sum" view of the world. If everyone is attempting to reach the same goal, continues Toffler, there isn't enough for everyone. But if each sub-culture has different goals, many of these can be accommodated. Established static political parties may be replaced by modular parties and shifting alliances among them. Mediators will be needed to work out relations among these diverse groups. Mark Gerzon in A Choice of Heroes (1982) identifies the mediator who can work with both sides of a conflict in order to enable them to reach a satisfactory accommodation as the type of "hero" we will need instead of the strong, dictatorial leader. (ii) The second key mentioned by Toffler is semi-direct democracy. The increasingly complex nature of socio-political-economic problems, due in part to the changing nature of our technology demands that we develop a way to get expert information to make informed decisions. Toffler suggests eoectronic voting by all the voters in a variety of referenda. It would appear that such voting has to be based on access to a great deal of information, and the suggestion does not seem as practical as some others Toffler makes. (iii) Finally, Toffler cites decision division as a key to democracy in the future. Making more decisions at local levels or global level will be possible as we become more adepts at identifying the locus of the problem, and allowing for decision-making at the appropriate level.

4. Another trend identified by Naisbitt is that short-term thinking will be replaced by long-term considerations. He discusses the effects of short-term, profit-oriented decisions bv businesspeople. The confluence of changing values and economic necessity will force those

making corporate decisions to take a long-range view. In discussing the same general topic, Toffler states that "third Wave" industries will have to pass the tests of being econogically and socially beneficial as well as economically sound. (1980, p. 152) Naisbitt states that in order to accomplish the shift from short-range to long-range thinking, industrialists must decide what business they are in. The railroads failed, he says, because they saw themselves as in the business of railroading, not in transportation.

There is a lesson here for educators. What business are we in? If it is information transmission, the media, especially television and computers may be doing it better. Perhaps our business is in teaching young people to construct useful knowledge from information, to practice social skills, to become adept at mediation and conflict resolution and to be aware of the fragility of nature and the primacy of human social needs. In short, to become "Third Wave" people, not frustrated "Second Wave" people valiantly truing to presenve conditions which are no longer viable. In so doing we will enable them to be cognizant of the forces which are changing our culture and affecting their lives. They will be able to use this awareness to take as much control over their lives as possible and in so doing to be happier, more productive citizens. (Smith, Stanley and Shores, 1950)

5. The final trend of Naisbitt's which we will consider today is the shift from relying on institutional help to turning to self-help. The failure of large scale institutions from health-care facilities to schools and government to meet many human needs has led to people establish local help networks and to take responsibility for some aspects of their own care, for example in disease prevention.

All technology is double-edged. In a speech to the American Association for the Advancement of Science in January. 1984, Anna Harrison stated that the only technological innovation she had ever heard of which had no negative effects was the fly swatter. She pointed out that the subgroup in society which benefits from an innovation may not be the same group which also bears the burdens. Further, the time frame for the appearance of the burdens is different from—usually later than—the appearance of the benefits of an innovation. Finally, the magnitude of the benefits v. burdens may be very different. The challenge given by Dr. Harrison is that we can learn to use technology selectively to enhance the quality of life and to dispense the benefits and burdens more equitably to all groups in our society. Further, the negative consequences of technology, e.g. the increase in population due to medical advances such as antibiotics, do not indicate that we should not make further advances, but that we should be aware of and address issues related to the unplanned negative effects simultaneously with the introduction of the technology.

Other authors, for example Harvey Brooks in an article in Daedalus in 1980, state this idea as the need for trade-offs. We must decide between some areas of economic growth and environmental values; using science and technology to eliminate scarcity for everyone or compromising other goals such as individual freedom and democracy. (1980, p. 77-79) He comments that most research today is aimed toward extending the powers of people in the developed nations. These extensions of power represent improvements in their lives which are marginal and which may be increasingly offset by unforeseen effects in the near future.

"Wielding the Double-edged Sword."

One example of a case in which technology and social policy interacted to produce unfortunate side-effects is the effort in the early 1960's to use psychoactive drugs to allow many mental patients to leave the hospital. Psychologists and psychiatrists endorsed the idea that with the use of these drugs many people could be cured to the point where they could live in the outside world with a little help from community mental health cneters. This notion was based on the experience of a few patients in a few, well-run and staffed programs. When applied generally to the population of mental patients, the unique features of the successful programs were not duplicated. The desire of government officials to reduce the costs of care of the mentally ill induced them to embrace the idea enthusiastically; and the health professionals were glad to oblige with glowing accounts of success. Now, some twenty years later, the problem of the homeless illustrates the weankesses of the program. Many of the homeless are homeless because they lack the ability to function at a minimally adequate level in the society. (Science Times, New York Times, Tuesday, Oct.30, 1984.)

Technological literacy for the Twenty-first Century, then involves a new view of nature and of humans' relation to the rest of the world of living things. It involves an awarene$$ of the double-edged nature of any technological innovation.

In the past, in Western culture, the relation of humans to nature has been one of domination, and technological innovations were viewed as unadulterated blessings. We have sought ever-increasing control over nature in order to secure our own physical security and comfort.

Now we have achieved that goal to a startling extent. In fact, we are discovering that our powers are double-edged. We are so comfortable that we have become weak and are more vulnerable to some conditions such as heart disease, since we don't have to use our bodies vigorously in order to survive. So we have begin to use them vigorously in recreational pursuits in order to survive.

This much is clear now. What is less clear is the effects our continuing technological advancement will have. Will it change us in ways we will some years hence find undesirable? Will we do math for recreation in order to keep our minds alert once we have let computers take over most computation for us?

Are we heading, as Jeremy Rifkin states in Algeny, for a human-engineered world which is efficient, smoothly running and physically safe, yet devoid of spontaneity, surprise and, most importantly, companionship and relatedness to other living things?

There is an alternative. It is to redefine our relationship with nature. Having achieved domination to the point at which most dangerous diseases and natural events can be predicted, if not controlled, we are in a position to see nature less as a threat and more as a companion. We need not view nature as a harsh enemy to be controlled as did our forefathers who with their puny tools proceeded to survive in the wilderness. We can change our view to see nature as a larger entity of which we are a part. We can see other living things as beings which have intrinsic value and with which we can be companions and fellow-travelers on this planet. We can sacrifice some measure of immediate physical security and control of the future in order to preserve the natural world. This is the world-view of the "Third Wave" humans.

To summarize, we have touched on a number of areas in which society and culture interact with technological innovation. The effects of each on the other are far-reaching and intimately tied into all aspects of our cultural system.

In attempting to develop technological literacy in our students, some of the important viewpoints we can encourage are (1) A wholistic view of society and culture, an understanding of conflict as part of the necessary tension within a cultural system, and ways to resolve conflicts to reach a new qualitatively different, but satisfactory state of dynamic equilibrium. (2) A feeling that they can understand some aspects of technological change, its effects on their lives, and some ways they can use to achieve some measure of control over their lives. (3) A respect for the natural world, for other creatures as beings with intrinsic value, which have become relatively vulnerable compared to human powers during the past half-century.

Introduction to the Activity Sheet.

This exercise in assessing technological innovations and their likely effects has two parts. One has students take a historic view of an innovation the effects of which are now known. The second part asks them to speculate intelligently about the likely effects of an innovation currently being introduced.

This activity could be an introductory task and form the basis of research, information procuring and processing and a vehicle for practicing such skills as distinguishing fact from opinion, identifying authors' biases, and writing summaries. The final product could be a written, oral or graphic presentation.

Alternatly, it could be the activity which culminates a unit on for example, late Nineteenth and early Twentieth Century U.S., providing students a framework within which to tie together historic information and its effects on the present.

While we will do this activity in one afternoon, using our information and observations . Students will need several class periods to collect information to use in order to intelligently classify the effects they identify, and to add or delete effects from their lists.

REFERENCES

Bell, Daniel. The Coming of Post-Industrial Society: A Venture in social Forecasting. New York, N.Y.: Basic Books, Inc., 1973, 1976.

Brooks, Harvey. "Technology, Evolution, and Purpose." Daedalus. 109, 1, 1980.

Buckley, Walter. Sociology and Modern Systems Theory. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967.

Gerzon, Mark. A Choice of Heroes: The Changing Faces of American Manhood. Boston, MA.: Houghton-Mifflin Company, 1982.

Grobstein, Clifford. A Double Image of the Double Helis. The Recombinant-DNA Debate. San Francisco, CA.: W.H. Freeman Company, 1979.

Hannay, N. Bruce and Robert E. McGinn. "The Anatomy of MOdern Technology: Prolegomenon to an Improved Public Policy for the Social Management of Technology." Daedalus. 109, 1, 1980.

Harrison, Anna J. "Common Elements and Inter-connections." Science. 1 June, 1984.

Baisbitt, John. Megatrends. New York, N.Y.: Warner Books, 1984.

New York Times, Science Times, "How Release of Mental Patients Began." Tuesday, October 30, 1984.

Postman, Neil. Teaching as a Conserving Activity. New York, N.Y.: Dell Publishing Company, 1979.

Rifkin, Jeremy. Algeny. New York, N.Y.: The Viking Press, 1983.

Shamos, Morris H. "Science for Everyone?" Education Quarterly. XIII, Summer, 1982. Education Digest, February, 1983.

Smith, B. Othanel, William Stanley and J. Harlan Shores. Fundamentals of Curriculum Development. Yonkers-on-Hudson, N.Y.; World Book, Co. New World Education Series, 1950.

Toffler, Alvin. The Third Wave. New York, N.Y.: Bantam Books, 1980.

Turkle, Sherry. The Second Self: Computers and The Human Spirit. New York, N.Y.: Simon and Schuster, 1984.

N.C.S.S., 1984

WIELDING THE DOUBLE-EDGED SWORD

Techniques for teaching about technology-related social issues.

Sara F. Anderson
Northern Virginia Commu-ity College, Annandale, Va.

INTRODUCTION.

These activities are designed to call students' attention to the double-edged nature of technological innovations, and to assist them in learning to assess the likely effects of particular innovations on society and culture.

These activities could be used in a United States or MOdern European History course, in Economics or Contemorary Problems courses.

Follow-up activities could include the following.

1. Have students list and assign priorities to their values. Then have them decide whether the innovation they assessed will be one whose effects they value, or one whose effects they may try to alter in their personal lives.

2. Using the effects they have imagined will result from a particular innovation, have students write a story about their own lives at some future date when those effects have occurred.

3. Have students imagine what life would be like without the past innovation they assessed (e.g., electricity). This could be done in the form of a story or a list of ways in which their lives would be different.

4. Have students come up with a list of alternative ways certain tasks might be done in the absence of a particular past or persent technological innovation.

In evaluating these student projects, and in helping students as they work on them, you will have to be constantly encouraging them to think beyond the obvious ("We woulen't have electric lights; we could use kerosene lanterns") to the alterations to the whole system of our culture the presence or absence of a particular technology would/will make. For example, electrical labor-saving devices made housework less physically demanding and time consuming, ending the need for human servants and freeing women (and men, too, but especially women) for other activities--both volunteer and paid. Such chains of connections will help students see the way change in one part of the cultural system changes many other parts.

Wielding the double-edged Sword. S.F. Anderson

DIRECTIONS.

Choose one past technological innovation, e.g. electricity, the railroad, television, and answer each question in Part I. Base your answers on your knowledge of history and the effects that innovation has had. Condense your answers onto the chart for Part I.

Follow the same procedure for a current innovation-- personal computers, animal organ transplants to humans, in vitro fertilization of human ova, nuclear power plants. Base your answer on your observations of current trends as well as "brainstorming" for likely effects.

In doing both parts, keep in mind the nature of the cultural system. A change in one part causes changes in many other areas of the culture. In the past most of these systemic changes have been unplanned and unforeseen. With the advantage of several decades of experience, we now can be alert to the "double-edged" nature of any innovation,; it cuts toward the planned benefits for which we adopt it and but it also cuts toward unplanned detrimental, or at least surprising effects in other parts of the cultural system than the one in which the innovation is introduced.

PART I. A HISTORICAL VIEW OF TECHNOLOGICAL INNOVATIONS.

1. List all the effects you can think of for one technological innovation introduced into our culture during the past 85 years.

2. Categorize the effects on your list according to whether they were planned and/or foreseen by those who introduced or eagerly adopted the innovation or were unplanned and unforeseen.

3. Indicate which effects were felt only in a local area, which were felt regionally, nationally and globally.

4. Divide the effects on your list into those you consider "positive." that is benefitting people in general and "negative," that is those which were harmful.

5. In the "Quality of Life" column of the chart, list four factors you consider essential to a good quality environment for lhuman beings, and which influenced your choices in item # 4.

6. Which subgroups in society benefitted most from the innovation you are assessing? Which subgroups of society bear (or did bear) the majfority of the burdens of the negative effects? List two reasons for the inequitable distribution of benefit and burden.

7. What was the timelapse between (a) the scientific or technological discovery which made the innovation possible and its widespread introduction or adoption? (b) between the planned benefits and the appearance and/or awareness of the burdens?

8. (a) What actions have been/are being taken to alleviate the burdens? (b) Who (government, industry, consumers) are taking these actions?

PART I, Cont'd.

8. (c) Who is paying the cost of alleviating these burdens in money?
(d) Who is paying the cost of alleviating these burdens in Quality of Life?

9. What areas of CHOICE did the innovation open up for individuals?

10. What choices did the innovation open up for society in general (seen most likely in legislative and judicial decisions)?

PART II. AN ASSESSMENT OF THE LIKELY EFFECTS OF A TECHNOLOGICAL INNOVATION CURRENTLY BEING ADOPTED.

1. Using your observation of current trends and by "brainstorming" imagine the effects some current new technology may have during the next two decades.

2. Indicate which effects are planned or hoped-for by those urging the adoption of the innovation and by those adopting it. Indicate which effects on your list are "unplanned."

3. Categorize the effects according to how widespread they will be--local, regional, national and global.

4. Divide the effects on your list into those you consider "positive," that is they will be beneficial to humans or to our society, and which you consider "negative" or harmful to individuals or to our society.

5. In the "Quality of Life" column on the chart, list four factors
c you consider essential to a good quality environment for human beings, and which influenced your choices in item #4.

6. Which subgroups in our society will likely benefit most from the innovation you are assessing? Which subgroups will bear the majority of the burdens or negative effects. List two reasons for the inequitable distribution of benefit and burden.
(a)

7. What has been the timelapse between the scientific or technological discovery which made the innovation possible, and its current status as a technological innovation being widely adopted?
(b) What timeperiod is likely to elapse between the planned benefits and the appearance of the burdens resulting from the innovation?

8. (a) What actions are being/might be taken to alleviate the burdens?
(b) Who (government, industry, consumers) are taking/will take these actions?
(c) Who is paying/will pay the cost of alleviating the burdens?in money?
(d) Who is paying/will pay the cost of alleviating the burdent in Quality of Life?

9. What areas of CHOICE are being opened/ will open up for individuals?

10. What areas of CHOICE are being opened up for our society, and what will be the best forum (government, industry, other groups) to make these choic

WIELDING THE DOUBLE-EDGED SWORD

Chart for Assessing Technological Innovations

Sara F. Anderson

Innovation being assessed

EFFECTS	PLANNED	UNPLANNED	NEGATIVE	POSITIVE	GROUPS BENEFITTED	GROUPS HARMED	QUALITY OF LIFE	TIME(a)	TIME(b)	ACTIONS/COSTS